Wind Atlas in Northern European Seas: the EU-Norsewind project

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Wind Atlas in Northern European Seas: the EU-Norsewind project

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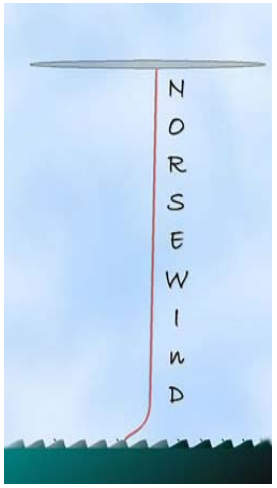
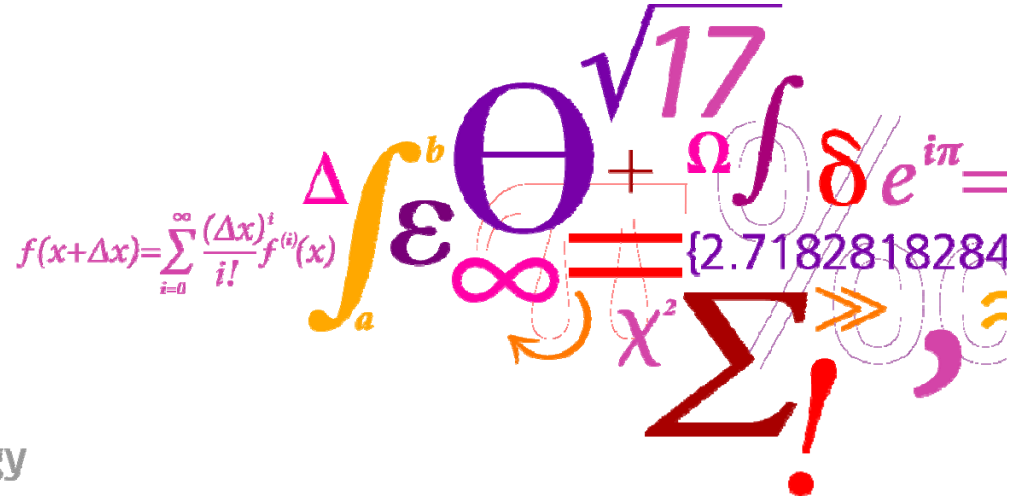




Risø DTU
National Laboratory for Sustainable Energy

EERA – Wind Conditions Workshop, 26-28 January 2011

Norsewind

Norsewind: Northern Seas Wind Index Database

2008 to 2012 (4 years)

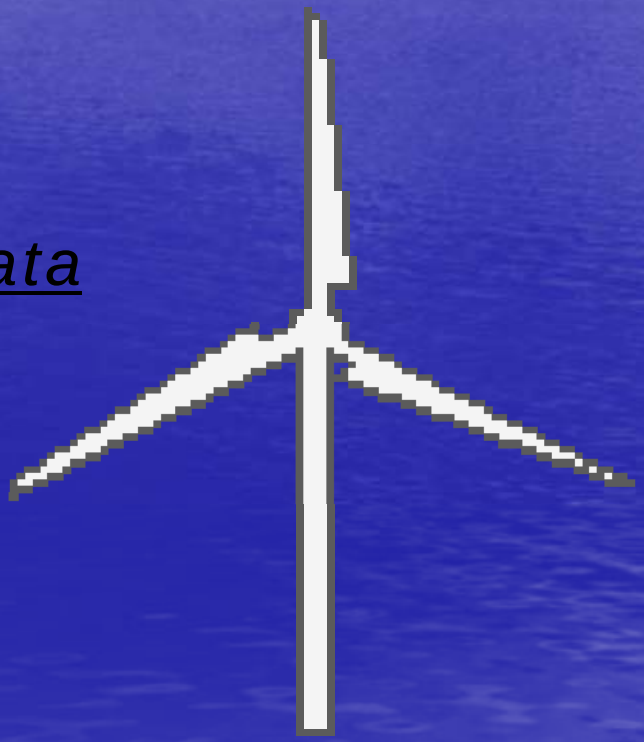
FP7 EU TREN 3.9 mio Euro

WP1: Lidar, satellite and met-data

WP2: Database

WP3: Shear and flow

WP4: Wind atlas



www.norsewind.eu

EU-Norsewind

Aim

- Aim is to produce a wind atlas for the Northern European Seas including the Baltic, Irish and North Seas.

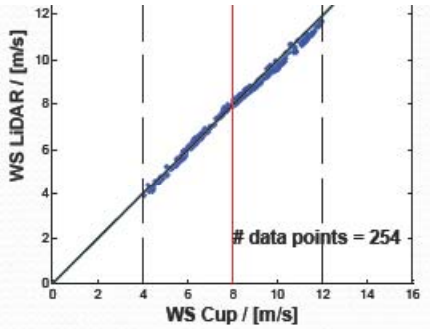
Method

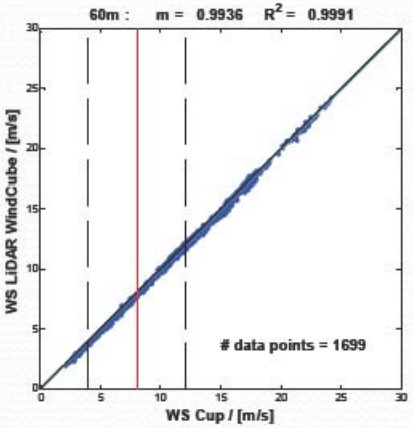
- Ground-based using 15 lidars and some met-masts.
- Satellite-based wind mapping.
- Atmospheric modeling.
- Testning for location offshore Portugal.

Lidar testing at Risø DTU

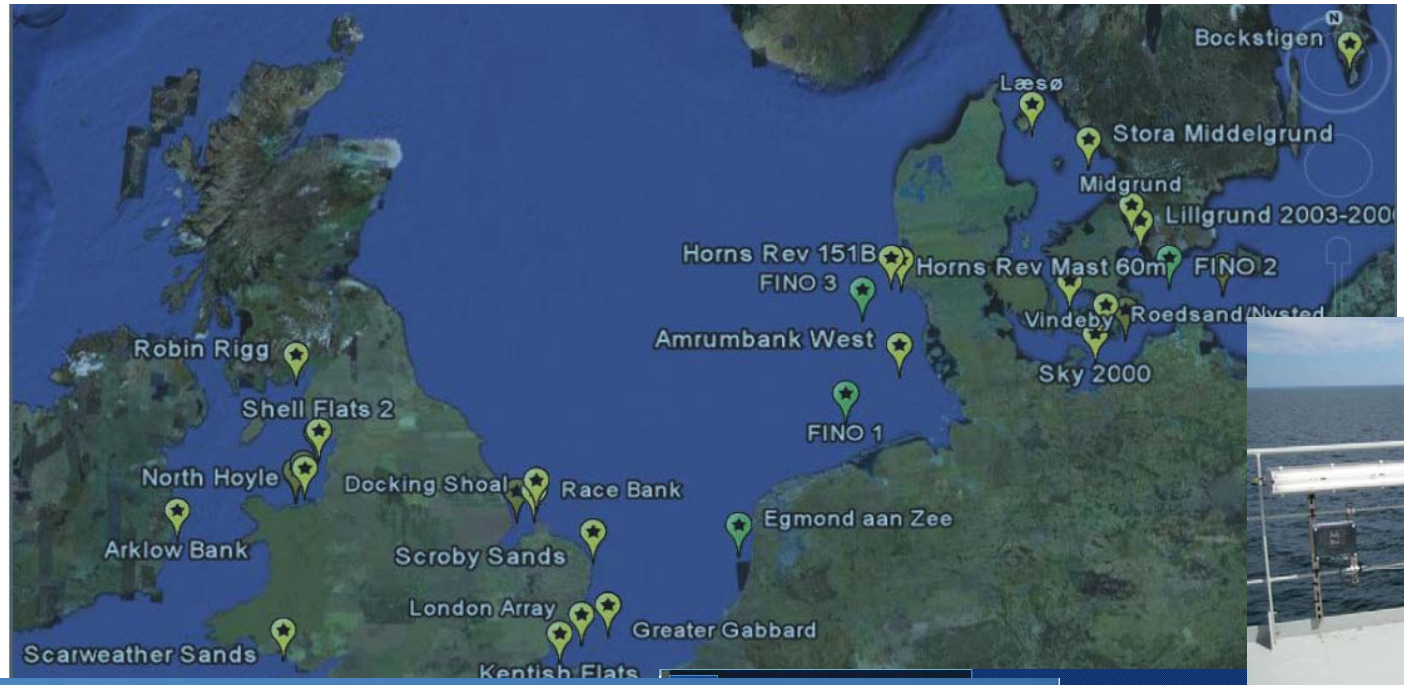
EERA – Wind Conditions Workshop, 26-28 January 2011

Lidars



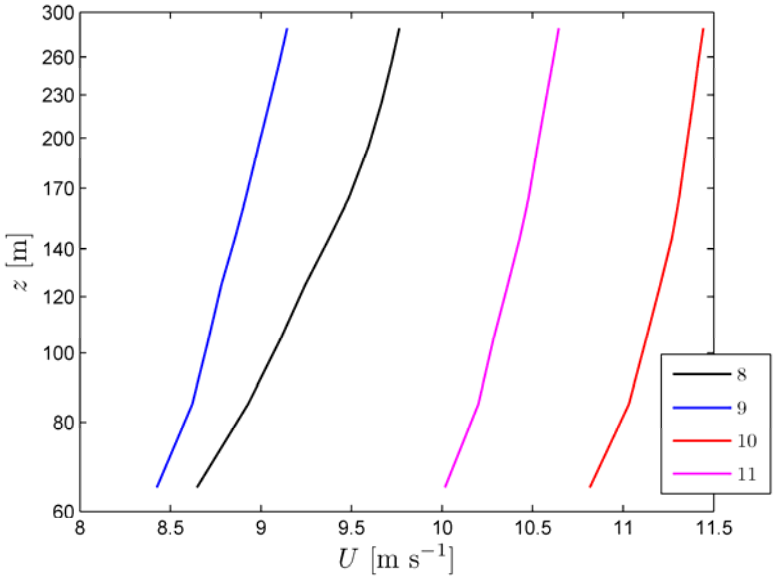


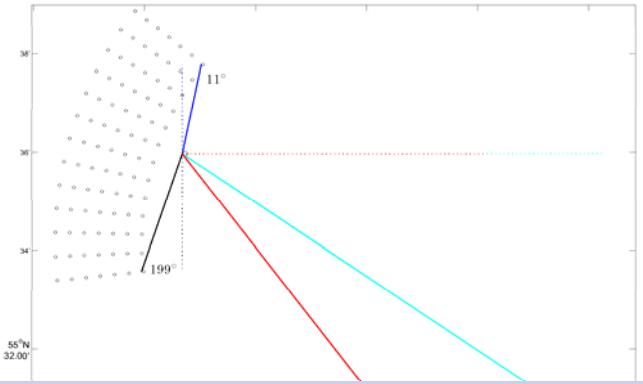
Oldbaum Services


Bockstigen
Læsø
Stora Middelgrund
Midgrund
Lillgrund 2003-200
Horns Rev 151B
Horns Rev Mast 60m
FINO 2
FINO 3
Vindeby
Roedsand/Nysted
Amrumbank West
Sky 2000
Robin Rigg
Shell Flats 2
FINO 1
North Hoyle
Docking Shoal
Race Bank
Egmond aan Zee
Arklow Bank
Scroby Sands
London Array
Greater Gabbard
Scarweather Sands
Kentish Flats


DONG
HRB

Data from DONG Energy





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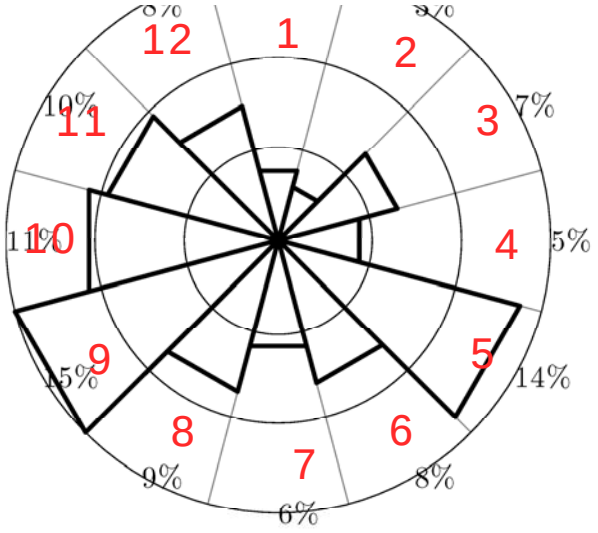

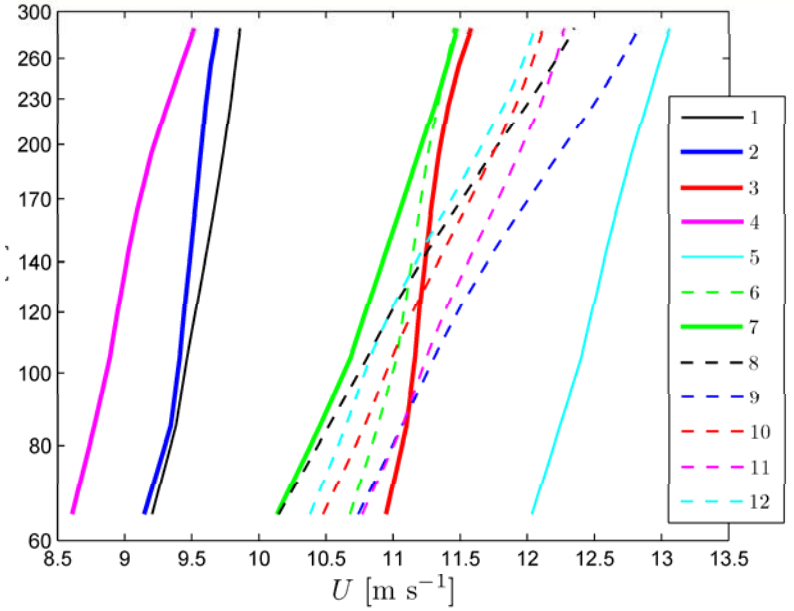

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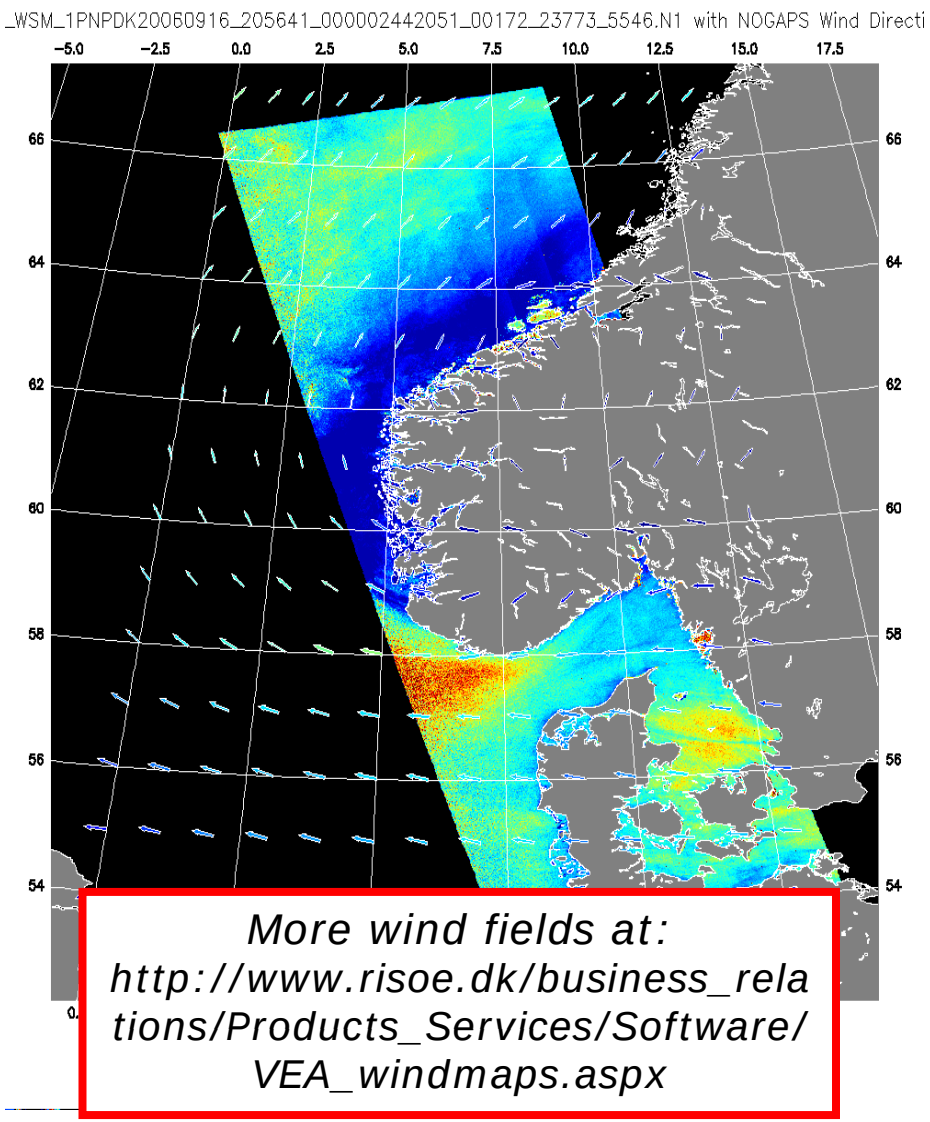
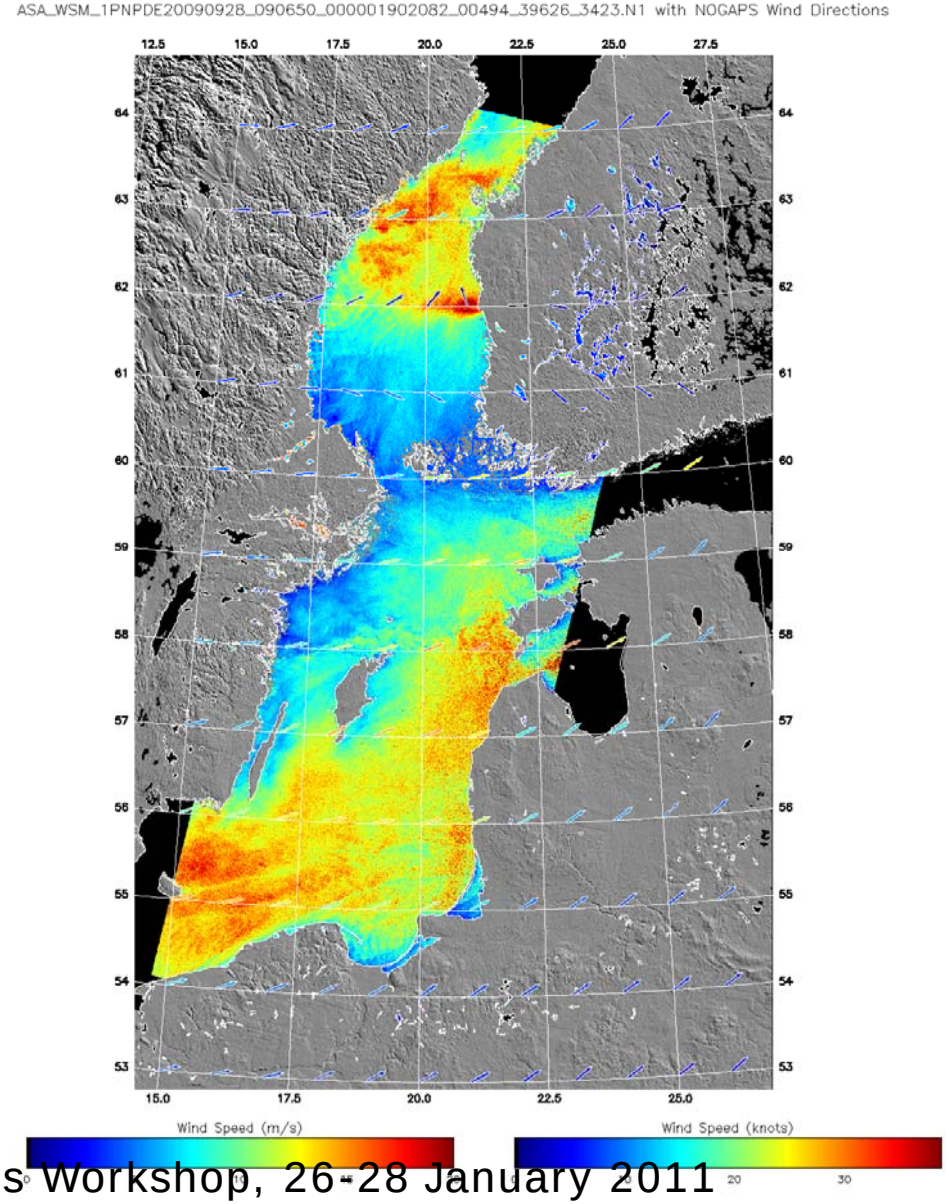
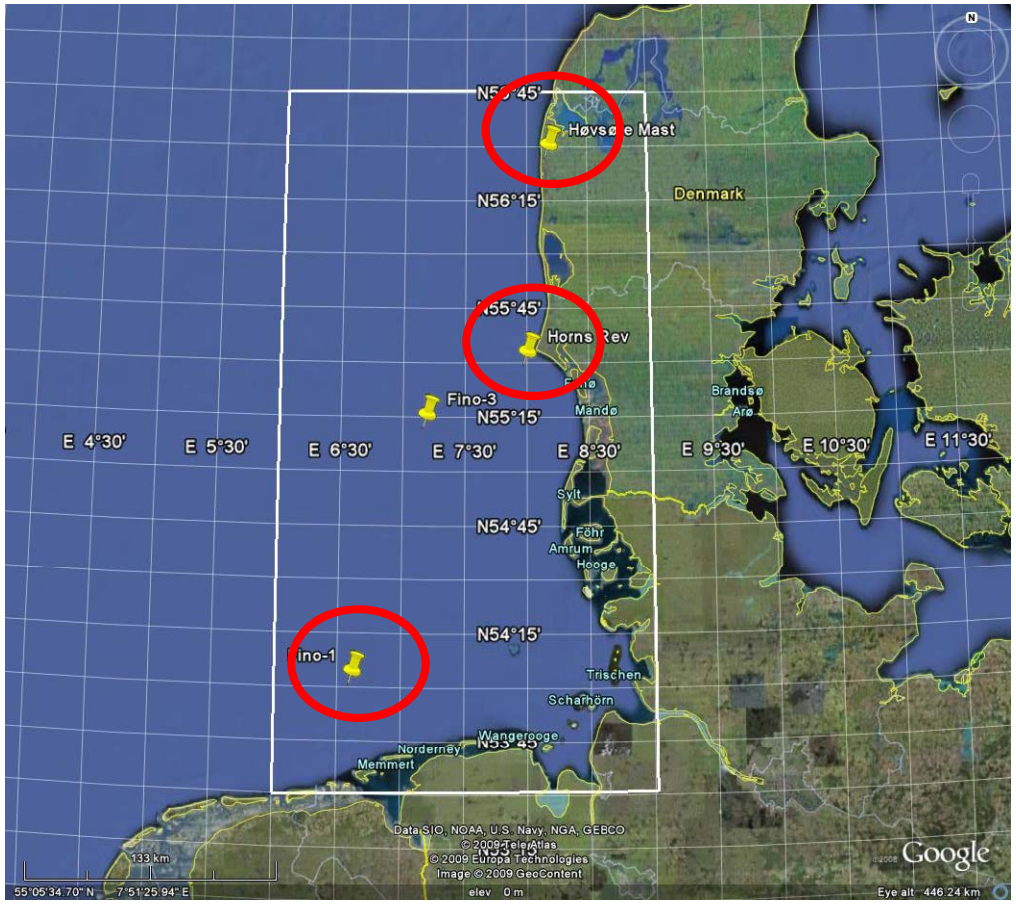
Envisat ASAR wind maps





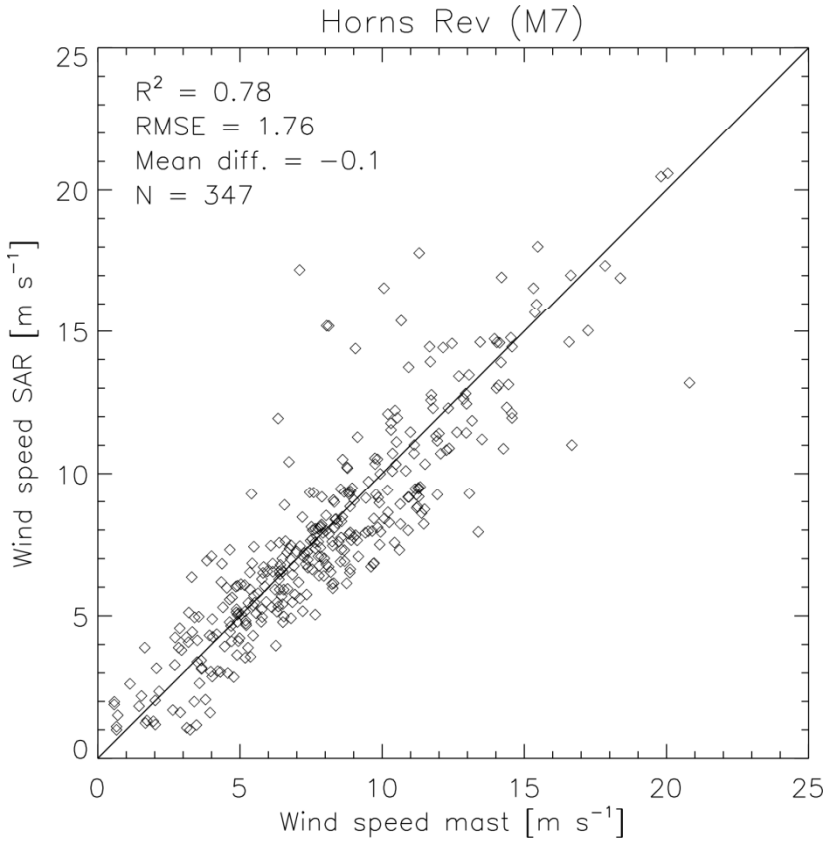
More wind fields at:
http://www.risoe.dk/business_relations/Products_Services/Software/VEA_windmaps.aspx

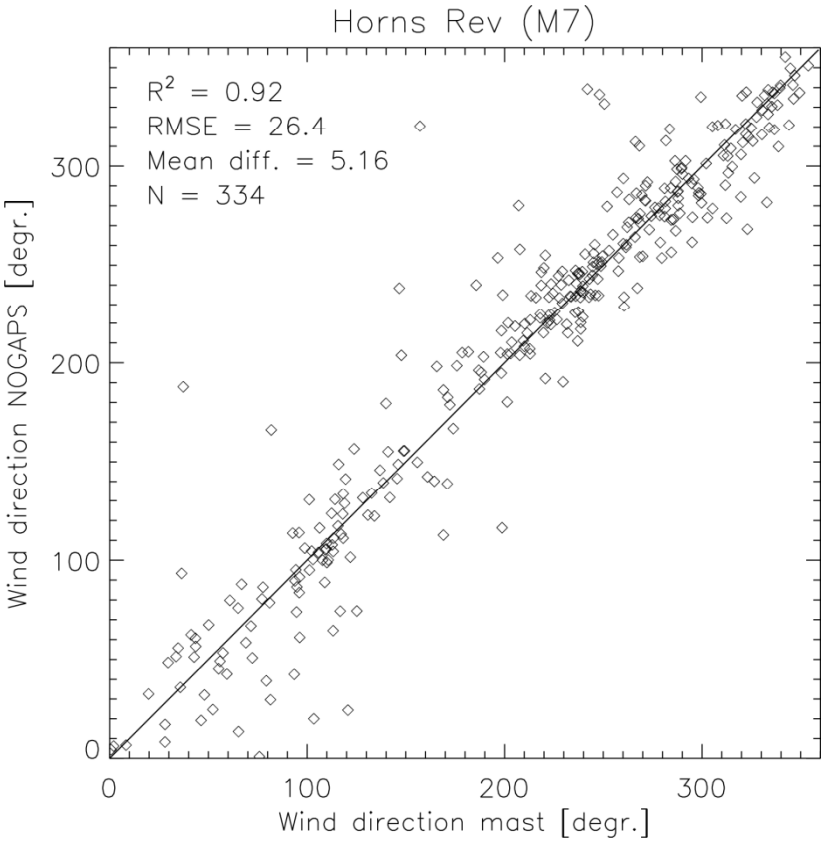
Wind resource mapping from Envisat ASAR



- Envisat ASAR since 2006
- Validation against:
  - *Three masts*

Horns Rev offshore station: Wind speed and direction



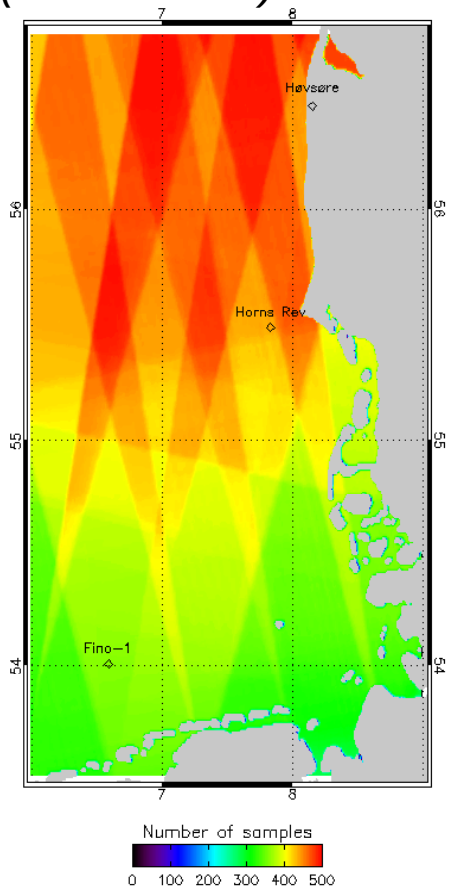


Hypothesis: SAR wind fields can be used accordingly to represent individual wind situations

Number of wind maps

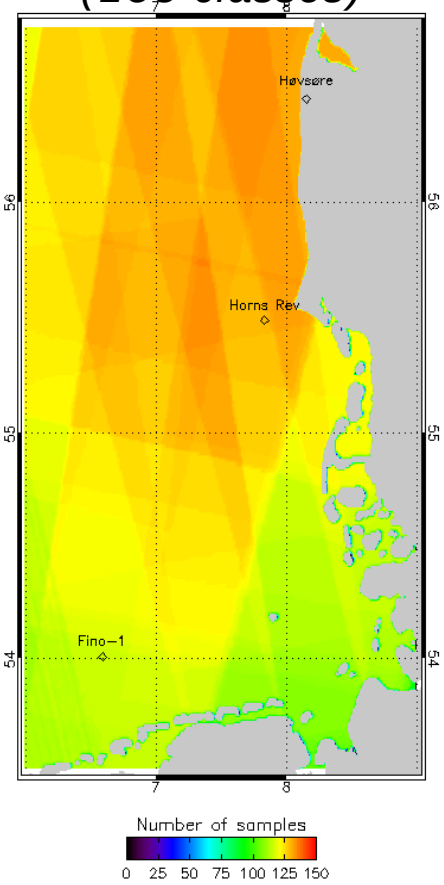
Risø DTU's full archive

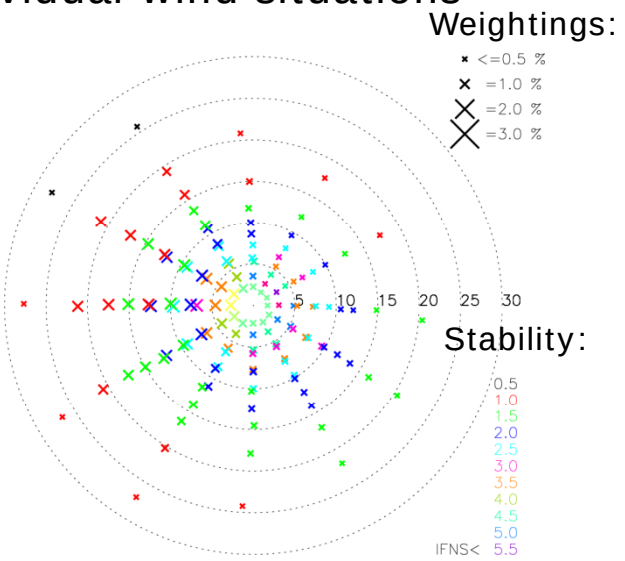
(627 scenes)



Wind class selection

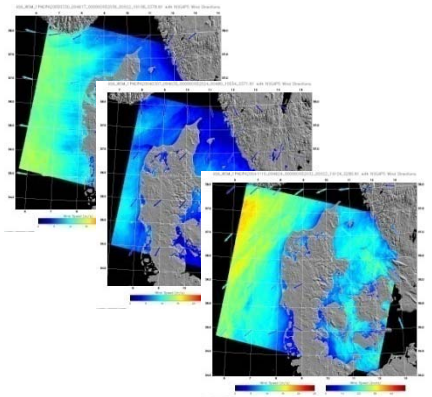
(135 classes)





Wind class definition

from NCEP/NCAR re-analysis data

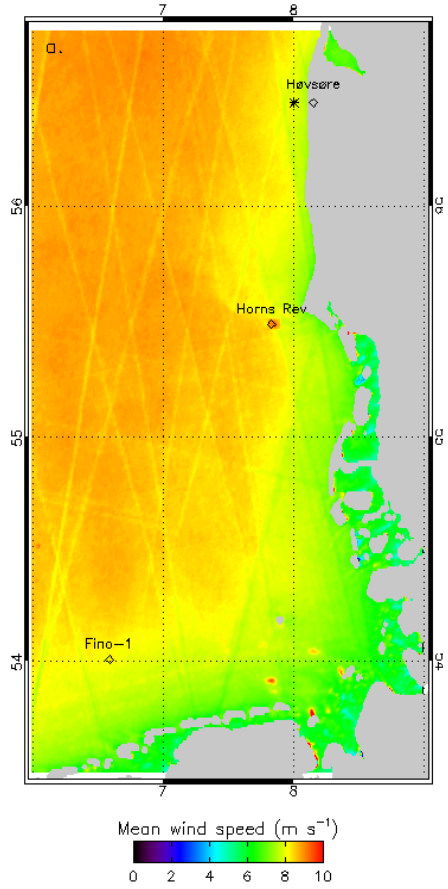


Population of each wind class

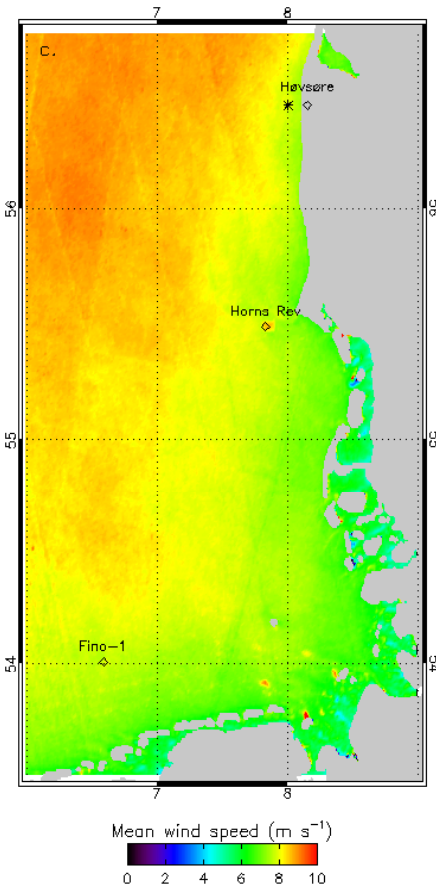
with a SAR wind field

Mean wind speed

(627 scenes):

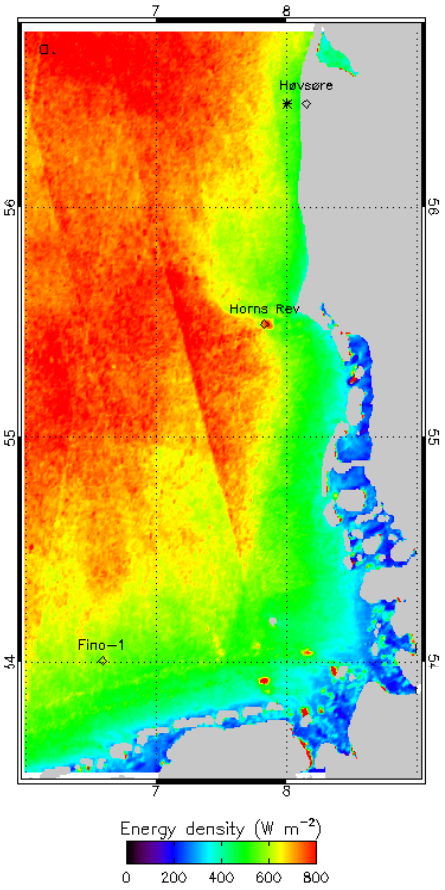


(135 classes):

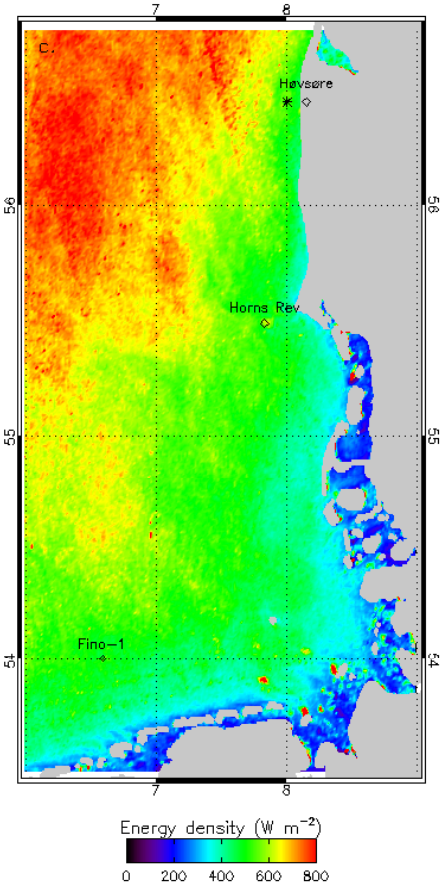


Energy density

(627 scenes):

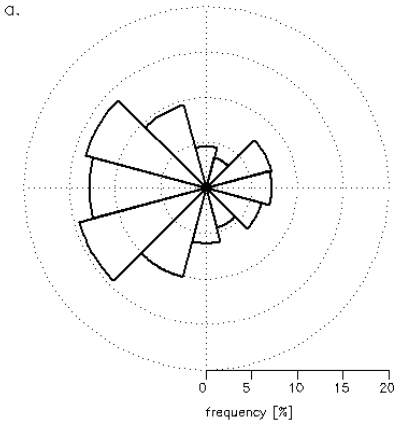


(135 classes):

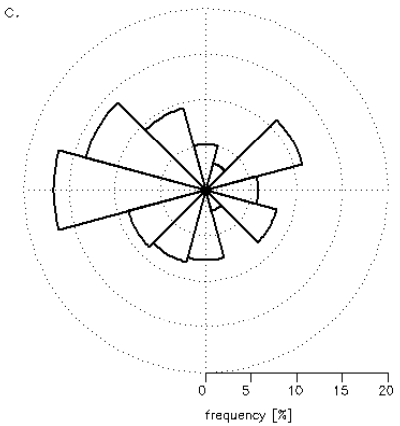


Høvsøre coastal station: Wind resources (2005-08)

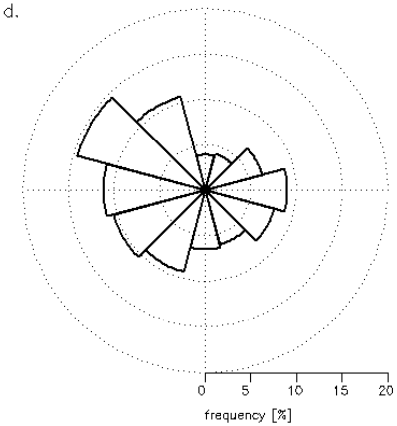
	N	U ($m\,s^{-1}$)	U-deviation (%)	A ($m\,s^{-1}$)	A-deviation (%)	k	k-deviation (%)	E ($W\,m^{-2}$)	E-deviation (%)
SAR, full data set	444	7.9	0.9	8.9	0.8	2.1	-1.0	551	3.6
SAR, wind class selection	128	7.8	0.6	8.9	0.6	2.1	0.0	542	1.8
Meteorological data	204 041	7.8	-	8.8	-	2.1	-	532	-



SAR, full data set



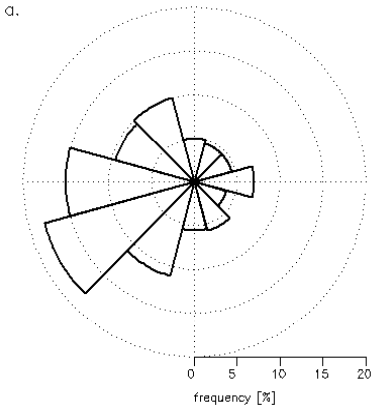
SAR, wind class selection



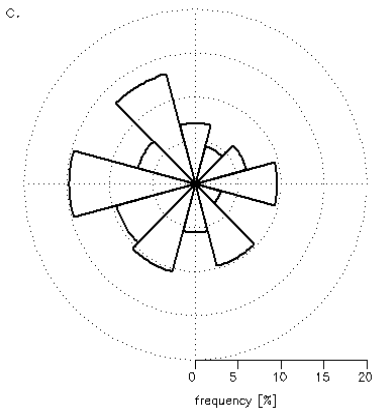
Meteorological data

Fino-1 offshore station: Wind resources (2005-08)

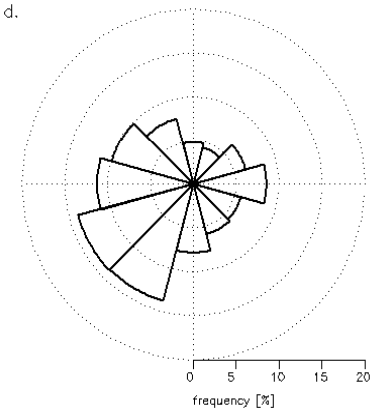
	N	U ($m\,s^{-1}$)	U-deviation (%)	A ($m\,s^{-1}$)	A-deviation (%)	k	k-deviation (%)	E ($W\,m^{-2}$)	E-deviation (%)
SAR, full data set	359	8.1	-0.1	9.2	-0.4	2.1	-5.1	584	4.1
SAR, wind class selection	116	8.0	-2.0	9.0	-2.4	2.1	-5.1	550	-1.9
Meteorological data	192 479	8.1	-	9.2	-	2.3	-	561	-



SAR, full data set



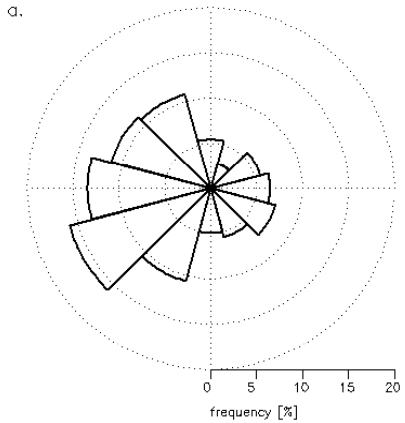
SAR, wind class selection



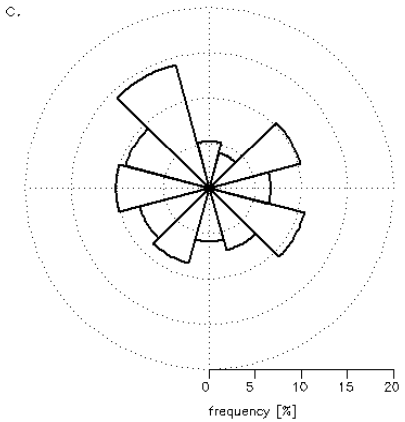
Meteorological data

Horns Rev offshore station: Wind resources (2005-08)

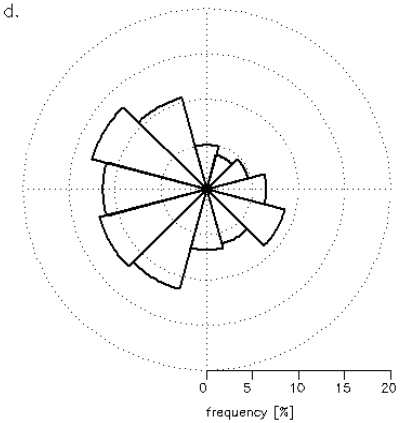
	N	U ($m\,s^{-1}$)	U-deviation (%)	A ($m\,s^{-1}$)	A-deviation (%)	k	k-deviation (%)	E ($W\,m^{-2}$)	E-deviation (%)
SAR, full data set	464	7.7	-0.8	8.7	-0.9	2.1	-3.6	504	0.9
SAR, wind class selection	127	7.5	-4.1	8.4	-4.3	2.1	-5.9	465	-6.9
Meteorological data	200 086	7.8	-	8.8	-	2.2	-	499	-



SAR, full data set



SAR, wind class selection



Meteorological data

Results summary for the wind class method

	Mean Error	Mean Absolute Error
U $(\mathrm{m\,s^{-1}})$	-1.8	2.2
A $(\mathrm{m\,s^{-1}})$	-2.0	2.4
k	-3.7	3.7
E $(\mathrm{W\,m^{-2}})$	-2.3	3.5

- Good overall agreement with mast observations on the wind resource
  - *within ±5% for the mean wind speed and Weibull A*
  - *within ±7% for the power density and Weibull k*

- The accuracy on wind resource assessment from mesoscale modeling is typically 10-15%

Norsewind consortium

Kjeller Vindteknikk; Statoil

OBS; Strathclyde University; Nautilus ; SE

DTU; DTU RISOE; DONG

Garrad Hassan;

3E

CLS

WINDTEST

IWES

LNEG

KNMI

Latvia

VTT

Oldbaum Services